

Nuclear Gauge Assessment for Marine Carbonate and Volcanic Soils

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Nuclear gauge wet density and moisture content readings were compared to direct measurements based on weights and volumes in an effort to ascertain the accuracy of the device for use with a range of local Hawaiian soils, including volcanic and calcareous materials. This follows concerns expressed by numerous users regarding certain high-moisture soils found throughout the state of Hawaii. Results indicate that while wet densities are quite accurate, moisture content readings obtained with a nuclear gauge may need to be offset at water contents above 45%. Further recommendations are presented on minimum count times, use of the gauge in the presence of very large soil particles, and the need for backup sand cone tests.

INTRODUCTION

The nuclear gauge is the most common method for measurement of in-place density and moisture content in construction projects. It provides obvious advantages in terms of speed, accuracy and convenience. Older methods of measurement, such as the sand cone and rubber balloon methods, are time-consuming and involve drying soil samples in an oven for a period as long as 24 h before in-situ density and moisture content can be known. This is often unacceptable in projects where grading and compaction need to proceed without undue interruption. The nuclear gauge can provide density and moisture content values in as little as 15 s.

In Hawaii, as in most other places, the nuclear gauge is widely used by engineering and testing firms. Many projects are carried out on behalf of the Hawaii Department of Transportation (HIDOT). However, the HIDOT has identified a number of concerns regarding use of the nuclear gauge, such as potentially inaccurate readings when using the gauge with certain soil types, as well as the lack of a consistent and streamlined set of procedures to be followed by contractors in order to optimize the reliability of reported results. The second concern is being addressed with the development of new guidelines for the use and calibration of individual gauges. This article focuses on the first concern: the use of the gauge with certain classes of soils.

The impetus for this study was a series of potential problems raised by local users, which included the following (Felkel, 2008):

- Certain fine-grained soils with high plasticity may have high hydrogen content (or high carbon, iron, boron or cadmium content) that can cause the gauge to produce false moisture content readings. In fact, 47% of surveyed users report problems of this type (Fig. 1).
- Coarse-grained soils with particles that are large in relation to the nuclear gauge measurement volume may produce highly variable wet density results (Fig. 2).
- Contractors are not clear on how accuracy differs among standard 15-s, 1-min and 4-min count times. In fact, a majority of them use the quicker 15-s count time (Fig. 3).

- Most clients require that sand cone tests be conducted at regular intervals to serve as a check on the reliability of the gauge values. A question often asked is how close nuclear gauge density and moisture values are to those obtained with the traditional sand cone.

Have you experienced problems testing with fine-grained soils?

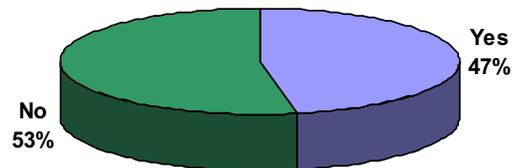


Fig. 1 Percentage of surveyed users experiencing problems with fine-grained soils

Have you experienced problems testing with gravelly soils?

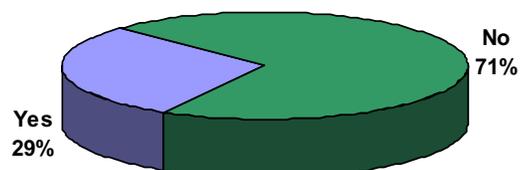


Fig. 2 Percentage of surveyed users experiencing problems with coarse-grained soils

What testing count time do you use?

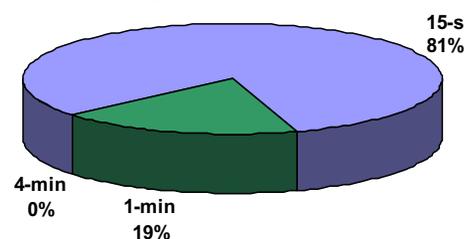


Fig. 3 Count times used by nuclear gauge users

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